EFFECTS OF IMPACT VELOCITY AND STRESS CONCENTRATORS IN TITANIUM ON FAILURE BY ADIABATIC SHEARING

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13. ABSTRACT (Maximum 200 Words)

This Interim Report covers the contract period from Feb. 18/2000 to June 17/2001 (third period of threee months). During that period a series of tests on the Modified Double Shear specimens (MDS) of different notch geometry loaded by direct impact has been completed. Impact velocities applied were within the following limits : 10 m/s <V<90m/s (nominal strain rates $5*10^3$ 1/s < T < $4.5*10^4$ 1/s). The followinggeometry of notches were tested : U-geometry and I-geometry. That is increased stress concetrators were applied. The material tested was Ti-6Al-4V, delivered by the ARL-APG-AMSRL. This series of tests was performed to complete testing at high strain rates with different stress concentrators and to compare results with the standard MDS geometry. Analysis of oscillograms obtained with those tests are almost finished.
Before testing the experimental setup for the direct impact loading has been improved. The experimental results show a substantial rate effects for all notch geometry. The failure criteria and the energy to failure are the tasks to be studied in the near future.

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EXTENDED ABSTRACT

During the third period (three months from Feb.18/01 to June 17/01) of the Contract the program was continued as it was being planned. After the tests were completed with the fast servo-hydraulic universal machine of LPMM on all four geometries of specimen, that is Standard (S-shape), U-shape, V-shape and I-shape, the direct impact technique, [1], has been applied for the last three geometry (U,V and I). Impact velocities were varied within the following limits: 10 m/s < V < 90 m/s (nominal strain rates: $5*10^3$ 1/s < Γ < $4.5*10^4$ 1/s. All tests were performed on titanium alloy Ti-6Al-4V, supplied by ARL-Aberdeen, MD. The specimens were machined in LPMM - Metz.

The earlier tests performed on the standard geometry, so-called Modified Double Shear (MDS), was a basis for further numerical calculations of Adiabatic Shear Bands (ASB). Improved constitutive relations had been used in those calculations, and one paper has been submitted in Jan./2001 to International Journal of Impact Engineering [2]. The tests performed recently on U, V and I geometry will be a subject of further analyses to identify failure criteria based on the concept of effective strain or on the strain energy density.

The LPMM-Metz has developed under previous contracts, partially granted by the European Research Office of the US Army, a unique experimental technique which enables impact shear testing of materials within a wide range of strain rates, the impact range covers strain rates from 10E3 1/s to ~10E5 1/s, [1]. This technique has been applied to perform experiments with three geometries of specimen, that is "U", "V" and "I", such geometries assure different stress concentrators. The main task is to find the role of stress concentrators in Ti-6Al-4V in triggering of ASB.

References

[1] J.R.Klepaczko, An Experimental technique for Shear Testing at High and Very High Strain Rates, the Case of a Mild Steel., Int. J. Impact Engng., **15**(1994), 25.

[2] A.S.Bonnet-Lebouvier and J.R.Klepaczko, Numerical Study of Shear Deformation in Ti-6Al-4V at Medium and High Strain Rates, Critical Impact Velocity in Shear, Submitted to Int. J. Impact Engng; (2001).

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